WORKING PAPER NO. 05-14
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TRANSACTIONS ACCOUNTS AND LOAN MONITORING

Abstract

We provide evidence that transactions accounts help financial intermediaries monitor borrowers by offering lenders a continuous stream of data on borrowers' account balances. This information is most readily available to commercial banks, but other intermediaries, such as finance companies, also have access to such information at a cost. Using a unique set of data that includes monthly and annual information on small-business borrowers at an anonymous Canadian bank, we find a significant relationship between loans becoming troubled and the number of prior borrowings in excess of collateral. Since the bank monitors the value of collateral (defined as accounts receivable plus inventory) at high frequency through the transactions account of the borrower, this unique access to useful information gives banks an advantage over other lenders. We also find that banks more intensively monitor loans that have a higher number of violations of the collateral limit.

TRANSACTIONS ACCOUNTS AND LOAN MONITORING

1. Introduction

Does observing transactions help financial intermediaries monitor borrowers? We provide evidence that information on the cash flows into and out of a borrower's transactions account can help an intermediary monitor the changing value of collateral – namely, accounts receivable and inventory – that a commercial borrower has posted for an operating loan. In this paper, we analyze a unique set of data that includes monthly and annual information on transactions account balances, accounts receivable, and inventories for small-business borrowers at a Canadian bank that wishes to remain anonymous. In particular, we test the hypothesis that the lender uses information from borrower transactions accounts to ascertain that operating loans are being used for normal operating purposes (financing inventory and accounts receivable) rather than financing unanticipated cash shortfalls and to detect and control moral hazard problems associated with a rising probability of bankruptcy.

We establish that the transactions account provides useful information to the lender and characterize how the lender responds to the information. Specifically, we find first that monthly changes in accounts receivable are quite transparently perceivable in movements in the transactions account, especially when the borrower has an exclusive banking relationship with the lender. Our second finding is that the number of prior borrowings in excess of collateral is a clear predictor of credit downgrades and loan write-downs, and the lender uses this information promptly. Our third finding is that the lender intensifies monitoring as loans deteriorate – loan reviews become lengthier and are more frequent.

Taken together, these findings establish a set of links showing that financial intermediaries can, and do, use transactions accounts to monitor accounts receivable and inventories; and we show how this one particular bank does so. Our finding on the transparency of changes in accounts receivable and transactions accounts covers more than 1200 firm-months of data. Even though our data come from a particular bank, the bank does not control these cash flow movements (most obviously for healthy

borrowers). Thus, in our view, the results based on this data set are likely to be broadly representative of how transactions account information can be used to monitor collateralized asset-based loans to small-business borrowers in general.

Transactions account information is most readily available to commercial banks, but it is also available to other types of lenders, such as finance companies. According to Udell (2004), finance companies and other asset-based lenders typically require their borrowers to establish special bank accounts in order to keep track of loans collateralized by accounts receivable. This deposit account, called a cash collateral account, is used strictly for the purpose of receiving all remittances on collected receivables. If the asset-based lender is not a bank, then the account is set up at a bank that works with the asset-based lender. Remittances are sent to this bank and typically are held for several days by the bank to cover deposit collectibility. Then the asset-based lender draws down these funds and applies them to reducing the loan. The borrower sets up a separate checking account from which it makes disbursements. The asset-based lender can monitor the cash flows into and out of these accounts to obtain the same kind of information on its borrowers that a commercial bank lender can obtain from the borrower's checking account.[1]

Since the asset-based lender needs to contract with another intermediary to maintain the transactions accounts while the bank lender maintains the checking account on its own, it is likely that the asset-based lender faces slightly higher costs for accessing the transactions account cash-flow information than would a bank. The bank's advantage over an asset-based lender may be greater when lending to less risky borrowers. That's because the bank faces higher regulatory costs than the asset-based lender, which means that any cost advantage from the checking account information may be offset by higher regulatory costs the bank faces when lending to risky borrowers. This could be one of the factors leading to finance

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[1]Indeed, by segregating the flow of funds from accounts receivable from other flows, these accounts allow the asset-based lender to more easily keep track of accounts receivable than in the checking account at the Canadian bank that we describe, which is a single account for payments in and out.

companies' specialization in lending to riskier borrowers, particularly more leveraged borrowers, as shown by Carey, et al. (1998).

That a commercial bank gleans information from transactions accounts at a slightly lower cost than a finance company supports the view of Black (1975) and Fama (1985) that banks are "special" monitors of borrowers because their role in the payments mechanism gains them privileged information.[2] However, that "specialness" has likely fallen over time, since declines in the cost of information processing and communication over the postwar period have likely lowered the cost of the duplication of bank services. This is one of the factors that has contributed to the substantial increase in finance company lending relative to commercial bank lending to businesses over the past 30 years.[3]

To our knowledge, this paper is the first direct empirical test of the usefulness of transactions account information in monitoring commercial borrowers. Previous empirical research has documented the value of lending relationships to firms by examining loan rates (e.g., Petersen and Rajan, 1994; Berger and Udell, 1995; and Berlin and Mester, 1998). Other studies have documented a positive abnormal stock-price reaction to announcements of new or continuing bank loan agreements or loan commitments (e.g., Lummer and McConnell, 1989; Billet, Flannery, and Garfinkel, 1995; and Preece and Mullineaux, 1996). Berlin and Mester (1999) present empirical evidence for an explicit link between banks' liability structure and their distinctive lending behavior. Yet none of these previous papers directly examines the mechanism through which a financial intermediary with access to transactions account data is able to gain an information advantage over other types of lenders. And this is the focus of our paper.

Recent papers by Kashyap, Rajan, and Stein (2002) and Diamond and Rajan (2001) offer alternative, complementary theoretical rationales for combining deposits and lending under a single roof. Kashyap, Rajan, and Stein (2002) argue that taking deposits and offering lines of credit are forms of liquidity provision that are optimally bundled together as long as they are not perfectly correlated. With

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[2]The importance of proprietary information and banking, using the example of R&D contests, is explored in Bhattacharya and Chiesa (1995).

such bundling, a bank is better able to hedge the risk of withdrawal. Gatev and Strahan (2003) provide evidence that banks can hedge liquidity risk from the commercial paper market because they receive offsetting inflows into transactions accounts. Our paper provides a rationale for those offsetting inflows: banks are best able to detect changes in risk because of superior monitoring capability. Diamond and Rajan (2001) argue that by taking deposits, banks commit themselves to bearing withdrawal risk. This commitment is beneficial, since it commits the bank to using its skill to collect from borrowers to repay depositors. (If a lender did not try to collect payment from borrowers, a run would be precipitated and the bank would fail.) This commitment means that deposits that are withdrawn from the bank to meet unforeseen liquidity needs can be replaced by new deposits, since new depositors are confident the bank will work to collect from borrowers to repay depositors. At the same time, borrowers are insulated from unforeseen liquidity needs of direct investors.

In this paper, we explore detailed micro data that show transactions account information is indeed relatively transparent for monitoring borrowers' collateral and that such monitoring is useful in detecting problems with loans.

2. The Mechanics of Loan Monitoring

When a borrower suffers unexpected losses, its probability of bankruptcy rises and, by a familiar moral hazard mechanism, its incentive to invest optimally falls (Myers and Majluf, 1984). A lender who monitors the borrower's account and is able to detect such losses may be able to create incentives for the borrower to take actions that improve expected return (Nakamura, 1993a). In particular, the lender may strive to ensure that the operating loan extended by the lender finances operations and does not finance unexpected equity losses. It is thus an important advantage to a lender to be able to detect changes in normal seasonal borrowing needs, i.e., flows of inventory and accounts receivable.

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[3] Data from the Federal Reserve Flow of Funds Accounts show that the ratio of finance company loans to commercial bank C&I loans has risen from about 17 percent in 1975 to 43 percent in 2003.

Although the banking literature cites a commercial bank's ability to monitor borrowers as one of its special talents, the literature rarely describes what gives the bank its monitoring advantage over other types of lenders. We argue that a commercial bank loan officer (or finance company lender) has access to fine-grained information about a borrower's activities through its operating account, as he or she can observe transactions on an item-by-item basis and compare them to the borrower's pro forma business plan. The continuing operation of a business demands that the business be able to meet its financial requirements, which means that the business must have enough cash to pay its employees, suppliers, and others. The cash flows of the business are recorded in its transactions account. This account information is likely to be one of the timeliest sources of information available to the lender. Moreover, as Nakamura (1993a,b) has argued, checking account information is relatively more transparent and complete for a small-business borrower whose banking relationship is exclusive to a single lender.

Borrowers at our bank are contractually required to provide a flow of information about accounts receivable and inventory, but this information may be unreliable. The loan contract restricts the amount of the loan to certain percentages of accounts receivable and of inventory. It also requires the borrower to report shipments to customers that constitute new accounts receivable, as well as customer payments on accounts receivable.[4] A borrower whose business is foundering may be tempted to submit false statements to boost the availability of credit, particularly if these reports are within the bounds of plausible error. For example, an account that has already been paid may be included among receivables. Or an order that has not yet been shipped may be called a receivable. However, by observing the detailed flow of payments received, the loan officer can verify that each receivable is followed, within 90 days, by a payment.

In fact, every month, the loan officer can do an item-by-item reconciliation of the accounts receivable: beginning-of-month receivables + sales (operating revenues; also new receivables) − cash inflows (checks) = end-of-month receivables. If the borrower accurately reports beginning-of-month, new

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[4]Appendix 1 shows language from a representative loan contract for the bank we study.

receivables, and end-of-month receivables, then the information on cash inflows is redundant. However, there will be an ever-present temptation to report inaccurately due to time pressure or to permit higher borrowing. The checking account provides a check not just on the veracity of the borrower but on how carefully the business manages accounts receivable, itself a telling sign. The converse is that if a lender cannot easily check on the accuracy of the borrower's statement, then the borrower may drift into habitual mendacity.

If the borrower were to attempt to cut off the flow of information by opening a checking account with a different bank without informing the lending bank, the absence of the borrower's payments for inventory and of payments received for accounts receivable would quickly reveal this chicanery. As we note below, when exclusive borrowers become troubled and their incentive to hide information rises, the information content of their transactions accounts deteriorates somewhat but remains high.

Finance companies, as we have pointed out, can establish relationships with banks that enable them to have similar access to bank lenders, but this does add an additional layer of expense. Many of the largest U.S. banks have established or purchased subsidiary finance companies.

Before continuing, it may be worthwhile mentioning that in the Canadian bank being studied, an operating loan is supplied as a negative-balance checking account, a typical practice in English banking. In the U.S., by contrast, the operating loan and the checking account are separated, with the checking account balance, at least in principle, required to be positive. Thus, the operating loan balance plus the checking account balance in the U.S. would be equal to the operating loan balance in this Canadian bank.

	U.S.-style Bank Account		English-style Bank Account (used by our Canadian bank)	
Assets		Liabilities	Assets	Liabilities
Transactions Account Balance = C_t		Loan = L_t		Bank Account = B_t

A lender without access to transactions account information in either the U.S. or Canada would observe only the loan balance. This would consist of a series of debits and credits between the firm's checking account at the firm's bank and the loan account at the firm's lender. In general, this lender does not see the individual payments the firm makes from its bank transactions account that pay suppliers, workers, and other creditors, nor those payments that are made into the account by clients. A bank lender (or other lender with access to transactions account data), on the other hand, using the English-style account, observes B_t, the payments between the borrower and the rest of the world, but there is no separate loan account. In contrast, a bank lender using the system prevalent in the U.S. observes C_t and L_t. Thus, the U.S.-style bank lender observes both the payments between the borrower and the rest of the world, and between the loan account and the transactions account. The U.S. bank accounting system provides somewhat more information than this Canadian bank's system, and it is possible that drawdowns of the operating loan may represent signals the bank can interpret. Thus, if anything, the results found using our Canadian data should indicate the lower bound on the information available in U.S.-style banking systems. On the other hand, the gross liability of the bank to the borrower and vice versa are greater under the U.S.-style banking practice because the transactions account and loan account are not netted.

The loans we are describing – whether from a bank lender or an asset-based lender – generally follow a standard sequence of inventory creation, shipment, and receipt of revenue. We will show that under normal circumstances, this sequence is revealed transparently, i.e., assets in the form of inventory and accounts receivable are mirrored in a sequence of payments in the bank operating account. A change

in these normal patterns of cash flows into and out of the operating account is a signal to the bank that the borrower may be experiencing unanticipated operating losses or other problems. This signal can trigger additional monitoring by the bank and renegotiation with the borrower.

The individual payments a borrower makes would be available to the borrower's bank lender. However, our data set does not include transactions account information detailed enough to verify individual payments in this manner. But it does allow us to demonstrate that the account balance provides a relatively transparent window on accounts receivable and inventory. In the empirical work described below, we use correlations between inventory, accounts receivable, and bank balance to judge how easily the bank balance can be used to monitor operations. We then show how this bank uses unexpected movements in the operating loan relative to inventory and accounts receivable to determine credit risk, intensify monitoring, and declare a loan troubled. We now describe our data set more fully and then turn to our empirical implementation and results.

3. The Data Set

The data contain information on 100 small-business borrowers who are customers of the Canadian bank. A small business is defined as one with authorized credit between C$500,000 and C$10,000,000 and whose shareholders are managers of the firm. The average sum actually borrowed in our sample is about C$1,500,000. The selected firms have been active for at least three years; public utilities, management firms, and financial companies are excluded. Fifty of these loans were declared troubled by the bank during the period studied (which falls between 1988 and 1992), and these loans constitute substantially all of the bank's troubled loans during this period that meet our criteria. Declaring a loan troubled is a highly consequential act for the lender, as it is the point when the bank acknowledges a high probability of loss on the loan. The other 50 loans in the sample were loans that remained healthy over the period studied and that matched the troubled loans along certain dimensions. That is, for each

troubled loan, we found a loan that remained healthy over the period studied and that matched the troubled loan by industry, level of annual sales, and loan amount.

The first panel of Table 1 shows the outcomes for the troubled loans. For the vast majority (36 out of 50, i.e., 72 percent) of these loans, the borrowing firms ended up going into bankruptcy or were privately liquidated.[5] Of the other loans, nine remained troubled, four were repaid, and one was upgraded. The Canadian category "troubled" matches reasonably well with the U.S. category "doubtful" and similarly requires a substantial write-down of assets.[6]

Most of these troubled loans were so classified between 1990 and 1992 (only three loans were classified as troubled before 1990); healthy loans were last reviewed by the bank at some date in 1991 or 1992. Six industrial sectors are represented in the data (see Table 2).
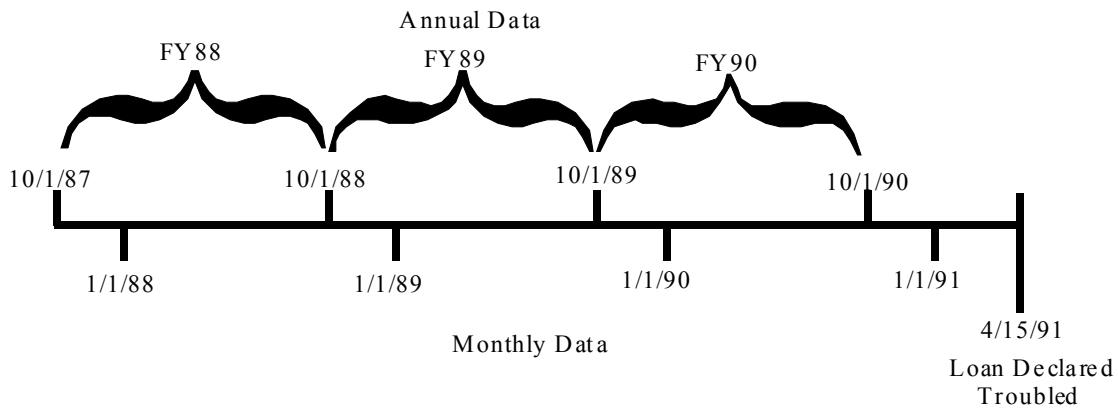
For each loan, we have both annual and monthly data. For a troubled loan, the annual data pertain to the firm's three fiscal years prior to the loan's being declared troubled, and the monthly data pertain to the three calendar years prior to the firm's being declared troubled. (The data are not necessarily complete for each loan.) For the matched healthy loan, we have comparable information, with the reference date being the last time the firm's credit file was reviewed by the bank. For example, consider a firm whose loan was declared troubled in April 1991 and whose fiscal year runs from October to September. Our annual data on this firm would cover the firm's fiscal years FY1988, FY1989, and FY1990, and the monthly data would run from January 1988 through December 1990.[7]

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[5]A private liquidation is a cooperative sell-off of assets without a court settlement. When the owner has signed a personal guarantee as a part of the loan agreement, such a private liquidation is likely to be efficient, as the owner is strongly motivated to maximize liquidation value of the firm and minimize his personal liability. Of course, if there are other claimants, liquidation may be complicated and bankruptcy entered into.

[6] "Doubtful" is one of the categories of "regulatory problem assets" identified by Treacy and Carey (1998) in their interviews with large U.S. banks. In the U.S. a "doubtful" loan has a recommended specific reserve of 50 percent. Such a loan has all the weaknesses inherent in a substandard loan and "collection/liquidation in full, on [the] basis of currently existing conditions, is highly questionable or improbable." For loans in this category, "specific pending factors may strengthen credit." The loans are treated "as loss deferred until [the] exact status can be determined" (Treacy and Carey, 1998).

[7]Because the reference dates for a matched troubled loan and healthy loan differ, the data on two matched loans could potentially cover substantially different time periods, with significantly different

Annual Data

FY88   FY89   FY90

10/1/87   10/1/88   10/1/89   10/1/90

1/1/88   1/1/89   1/1/90   1/1/91

4/15/91
Loan Declared
Troubled

Monthly Data

An important variable included in our data set is whether the firm has an *exclusive* banking

arrangement with the bank. In our data, of the 50 troubled loans, 33 of the borrowers have an exclusive

relationship with the bank; of the 50 healthy loans, 26 have an exclusive relationship.   This variable

allows us to segment the loans into "exclusive" and "nonexclusive" categories, providing a metric against

which we can partially measure the quality of the bank's information. In general, having more than one

banking relationship weakens the bank's information. We can subdivide nonexclusive borrowers into two

types: those with exclusive operating loan balances with our bank and at least one term loan (which

includes mortgages) with another bank, and those with operating loan balances with another bank. Of the

41 nonexclusive borrowers, 27 have exclusive operating loans while 14 have operating loan balances with

another bank. Among the nonexclusive borrowers, the quality of information on those with exclusive

operating loans would be higher quality than on those with nonexclusive operating loans.

Our bank has relatively little information about the borrowers with operating loan balances with

another bank. In 10 of these 14 loans, the borrower does not have transactions account information. The

bank in these cases generally relies on the other bank to monitor the borrower and is typically offering the

macroeconomic conditions. But this does not seem to pose a large problem here, since the difference in
reference dates was under two years in all but four cases, and the maximum difference was three and a

loan facility as part of the bank's relationship with the other bank. We cannot perform our tests on almost all of these borrowers. By contrast, with exclusive operating loans the bank is typically the primary lender, even though its relationship with the customer may not be as tight as with an exclusive client. When we analyze informational flows in section 4, the informational contrasts we draw between exclusive and nonexclusive borrowers will almost entirely reflect the contrast between borrowers who have exclusive client relationships and borrowers who have term loans at another bank (but operating loans at our bank).

3.1 Annual data

The annual data contain information typically found on a firm's financial statement, e.g., balance-sheet data, such as the book value of accounts receivable and inventories; income-statement data; some items from the statement of changes in financial position; and information in the firm's credit file. Our data set also contains some information from the outside auditor's report on the firm, e.g., whether there were any qualifications in the auditor's report and the date of the audit. These data would be available to any lender the firm approached for a loan. Nonexclusive borrowers generally tend to have larger sales and often represent borrowers who are being accommodated by our bank because they have a plant or subsidiary outside their primary bank's territory.[8]

The credit file contains annual information about the firm's sales, the level of authorized credit the firm has gotten from the bank for an operating loan, additional credit for seasonal loans, and other temporary loans. In addition, there is information on whether the loan has covenants. A crucial datum in each annual credit review is the credit rating assigned to the loan by the bank's credit department upon

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half years for one loan pair.

[8]One such borrower with unusually large sales of over $300 million distorts the data on "nonexclusive-troubled" borrowers. When that borrower is omitted, average sales for all three years falls to $14.5 million for troubled loans, to $18.8 million for nonexclusive loans, and to $24.5 million for nonexclusive-troubled loans. This borrower's data, fortunately, do not materially affect any of our other results. Indeed, when this borrower is omitted, the results of our statistical tests are, on average, slightly more favorable to our hypotheses.

completion of the review. This credit rating is arranged on a scale of one through eight, with one being the best, and six through eight being different degrees of "trouble."

The second panel of Table 1 shows some of the annual data on our borrowers. The first 4 rows show the average loan sizes (measured by the average amount actually borrowed) for all the loans and for the healthy and troubled loan subsamples over the entire three-year period covered by the data and over each year individually, where the years are measured relative to the reference date (i.e., for a troubled loan, the three fiscal years prior to the loan being declared troubled; and for a healthy loan, the three fiscal years prior to the firm's last credit review by the bank) cross-classified by exclusive and nonexclusive client relationships. It is evident that the bank does not use its information about troubled borrowers to substantially reduce its exposure to loss; rather, if anything, troubled loans rise in average size. Since the bank has very good information on exclusive borrowers, one might have thought that the bank would restrain lending to exclusive borrowers as they get into trouble. But we find that such loans continue to rise in size, on average, despite the deterioration of the borrowers.

The next four rows show the average annual business sales for all firms and for the healthy and troubled loan subsamples, again cross-classified by exclusive and nonexclusive relationships. Note that troubled borrowers do not generally have obviously declining average sales compared to healthy ones. Many of these troubled borrowers get into trouble by expanding too aggressively. As might be expected, firms that are larger, as measured by sales, tend to deal with more than one bank and so do not have an exclusive relationship with the bank under study.

The bottom panel of Table 1 shows the evolution of the borrowers' credit ratings over time. At the dates when the loans were matched (i.e., at t−3), there are 19 loans rated superior or standard in the group of loans that do not become classified as troubled loans and 31 such loans with substandard credit ratings. At the final rating period (t−1), there are 23 loans rated superior or standard. By contrast, although 18 of the troubled loans are rated superior or standard in the initial period, only one is so rated

two reviews later. The divergent movements of the two sets of loans are due to the selection process; all the loans that worsen to troubled are selected into the "troubled" group.

These credit ratings are effective on the date the credit department signs off on the credit review. This sign-off date is typically later than the planned credit review date, as the loan officer doing the review may ask the borrower for additional information. In addition, the interval between planned credit reviews is not always one year but may be shorter or longer.

3.2 Monthly data

The monthly data contain information on the value that the bank assigns to the firm's accounts receivable and inventories, as well as the end-of-month balance in the firm's bank account. The bank's *valuation* of accounts receivable and inventories is an important ingredient in determining how much the bank is willing to lend to a commercial borrower. To restrict the use of the operating loan to purely operational ends and to ensure that the borrower has adequate collateral for the loan, the bank verifies on a monthly basis that the amount borrowed does not exceed the estimated value of the firm's operating assets that serve as collateral. The underlying data on dated accounts receivable and inventories are reported to the bank by the borrower, as provided for in the loan contract.

The bank's valuation includes subjective discounts (haircuts) from book value (note, we do not have monthly information on these book values). These haircuts provide a comfort level for the lender; they also reflect the liquidity and quality of accounts receivable and inventories. For example, as accounts receivable remain uncollected, their quality (i.e., the probability they will ultimately be collected) may deteriorate. Also, the stage to which the inventory is processed reflects its liquidity – works-in-progress inventory is the least valuable, since it is the most difficult to convert to other uses and, therefore, to sell to other producers. In general, our data indicate that this bank values accounts receivable at two-thirds to three-quarters of book value, while it values inventories at between one-quarter and two-fifths of book value. The low valuation on inventories also reflects binding ceilings on the amount of inventory on which the bank permits the firm to borrow. On the other hand, credit rating does

not seem to have much impact on the size of haircut, although borrowers with a credit rating in the

"troubled" range may receive a bigger haircut on their accounts receivable than do other borrowers. This

presumably reflects the aging of some proportion of the accounts receivable.[9]

4. Empirical Results

4.1 The relationship between loan balances and the bank's valuation of accounts receivable

Next, we turn to the transparency of the bank balance in providing information on accounts

receivable. If we had complete data on loan balances, accounts receivable, and inventories, then, under

the hypothesis of transparency, almost all the movements in bank balances would be accounted for by

movements in accounts receivable and inventories. However, in our data, it appears that there is a limit

on the amount the bank is willing to lend against inventory. That is, there is a binding ceiling on the

bank's inventory valuation, so that changes in inventory are typically not reflected in our inventory

valuations data. For this reason, we focus on the relationship between loan balances and accounts

receivable. As discussed in section 2, to the extent that there is a high correlation between bank account

balances and changes in accounts receivable and inventories, changes in the firm's bank account balance

can be used to monitor a firm's operations. But how high can we expect this correlation to be?

Obviously, this will depend on the distribution of expenditures, shipments, payments on past shipments,

and other net outlays.   When inventory is shipped, the borrower writes down its finished goods

inventory, but the loan balance is unaffected. Loan balances change only in response to payments, which

represent only half of the changes in accounts receivable. This suggests that the correlation between

accounts receivable and loan balances should be positive and roughly one-half. In appendix 1, we

formalize this conjecture. Note that a similar calculation can be performed for the correlation between the

change in bank account balance and the change in inventories.

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[9]The mean haircut on accounts receivable was 0.29 for borrowers rated superior or standard and 0.36 for borrowers rated as troubled (with one of the three worst credit ratings). The mean haircut on inventories was 0.62 for borrowers rated superior or standard and 0.66 for borrowers rated as troubled.

To see whether the bank account balance gives the bank useful information for monitoring the firm's operations, we examined the correlations between changes from the beginning to the end of each month in the firm's checking account balance, and the bank's valuations of the firm's accounts receivable and inventories. As discussed in section 2, we hypothesize that the correlation would be stronger for firms that have an exclusive relationship with the bank than for firms that do not. So we repeat the correlation analysis for the exclusive and nonexclusive subsamples, and we also divide these subsamples into their healthy and troubled loan subgroups, to control for any loan performance effect. Thus, we perform the analysis for seven groups: all loans, exclusive, nonexclusive, exclusive-healthy, nonexclusive-healthy, exclusive-troubled, nonexclusive-troubled. In this analysis we normalize the variables by the firm's annual sales to control for heteroscedasticity.[10]

The correlation between changes in bank balances and changes in accounts receivable is 0.45 for all loans and is higher for exclusive loans (0.50) than for nonexclusive loans (0.40). Thus, our data for exclusive loans are showing about as high a level of correlation as one should expect. The correlations are stronger for firms that deal exclusively with the bank than for firms that have multiple banking relationships, even when we control for loan performance. This suggests there is more information to be gleaned about a firm's operations from the account balances for firms that deal exclusively with the bank than for those that have other banking relationships.[11] In addition, the exclusive-troubled borrowers' correlation between movements in the bank account balance and accounts receivable, at 0.44, is lower than for exclusive-healthy borrowers, but remains high. It is significantly greater than the 0.31 correlation coefficient for nonexclusive borrowers. (Based on Fisher z-scores, we can reject the hypothesis of equal correlation with a p-value of 2.3 percent.)

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[10]To normalize, we use the earliest annual sales figure available for each firm. For troubled loans, this is sales in the fiscal year three years prior to the loans' being declared troubled, and for healthy loans, this is sales in the fiscal year three years prior to the last credit file review.

[11]Not only would the bank have less data on nonexclusive firms, but the value of any information it had might be lower, since the firm would be less under the bank's control.

It appears that simply having a continuous record of the borrower's operating balance in an exclusive client relationship provides the lender with a substantial amount of information. Of course, the loan officer has access to even better information, as the loan officer can examine individual checks and deposits.[12]

The correlations between changes in inventories and changes in either bank balances or accounts receivable are much smaller than the correlations between changes in bank balances and accounts receivable. This is because there is generally much less variation in changes in inventory valuations than in the other variables. Indeed, roughly 20 percent of the monthly observations of the bank's valuation of inventories appear to be at an upper limit. These are cases where there are more than two observations at the same valuation and that valuation is the highest observed for that borrower. This bank's monitoring operation does not include collecting detailed information on inventory. This may be contrasted with those finance companies that focus on inventory, where lenders regularly make site visits to verify this collateral (Udell, 2004).

This analysis suggests that changes in accounts receivable potentially contain useful information about firm operations; however, our data do not permit us to reach a similar conclusion about inventories. The empirical analysis in the next sections attempts to determine whether indeed there is useful information and how the bank uses such information.

4.2 The relationship between signals of firm trouble, credit downgrades, and troubled firms

The monthly data allow the lender to detect two signals of potential trouble at the firm. The first signal is when the bank's loan balance exceeds the bank's valuation of collateral, i.e., of accounts receivable and inventory. The second signal is whether the borrower is consistently borrowing an amount close to or exceeding the credit line authorized at the beginning of the credit year. These two signals

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[12]Note that we also find a stronger correlation for healthy loans than for troubled loans, holding exclusivity constant. This may reflect the fact that when loans become troubled, the bank may lower its valuations and the loan limits may become binding on the firm. (It also suggests that the bank's control is not perfect.) This would disrupt the normal relationship between checking account balances and bank valuations of accounts receivable.

differ sharply on what kinds of lenders can use them. The first type of signal is likely to be accurate only

for lenders with access to transactions account data, since only such a lender can track the high frequency

movements in collateral valuations and thus can create a reliable signal based on them. Monthly

monitoring and valuation of accounts receivable and inventories are likely to be very difficult for a lender

who does not have access to the transactions account data we have documented as providing useful

information. On the other hand, a signal based just on information on the firm's account balance would

be available to any lender. Presumably any lender will know the extent to which the borrower is using or

even exceeding the authorized credit line. We compare the informativeness of these two types of signals

and are specifically interested in what *additional* information is provided by our bank's valuations of

collateral.

Our measures of these two types of signals are *exceed* and *utilization*. *Exceed* is the amount the

firm has borrowed less the firm's collateral (as measured by the bank's valuation of the firm's accounts

receivable and inventories and other guarantees posted by the firm), as a percent of the firm's authorized

credit line. *Utilization* is the firm's borrowing as a percent of its authorized credit line. Exceed is a signal

of trouble available to only a transactions-based lender, while utilization is available to any lender.

Troubled firms are likely to have higher, and possibly positive, values of *exceed* and higher values of

utilization. These higher valuations are usually due to excessive borrowing but also may on occasion be

due to declines in the bank's valuations of accounts receivable and inventory and in the borrower's credit

line.

Both *exceed* and *utilization* are computed using the monthly data on the firm, and thus, they are

likely to be better signs of trouble for exclusive borrowers than for nonexclusive borrowers, since the

bank has more accurate monthly data on exclusive borrowers. As expected, we found higher mean values

of *exceed* and *utilization* for exclusive-troubled firms than for exclusive-healthy firms. In our tests, we

focus on exclusive borrowers, as our theory and data suggest that banks have the best information on

these borrowers. However, broadly similar results are obtained for nonexclusive borrowers (all but one of the nonexclusive borrowers has an exclusive operating loan with our bank.)

When *exceed* turns positive, the bank is at risk, in that the borrower's ability to relatively quickly pay off the loan has become stretched. This is a warning signal to the loan officer and to the bank. How useful is this signal? We define a variable, *violations*, which equals the number of months for which *exceed* is positive over the three years prior to our reference date (either the date when a loan was declared troubled or the date of a healthy loan's last credit review). We also define *violations_i*, i=1,2,3, which is the number of months *exceed* is positive in the ith year before the reference date. Similarly, we define *nonviolations* and *nonviolations_i*, i=1,2,3, which are the number of months for which *exceed* is negative. Note that *violations* and *nonviolations* will not necessarily sum to 36. This can happen either because data are missing or because the firm is just borrowing an amount equal to the bank's valuation of its collateral. Months for which our data are incomplete so that *violations* and *nonviolations* cannot be computed, or months in which the firm's borrowing equals the bank's valuation of its collateral, do not count as positive or negative *exceed* and, therefore, do not increase either *violations* or *nonviolations*. Thus, the sum of *violations* and *nonviolations* would not equal 36. Therefore, we are able to include both *violations* and *nonviolations* in the regressions. This provides us meaningful information because lack of data has a different meaning from either violations or nonviolations, as suggested by the negative coefficients on nonviolations.

We are interested in two nested types of outcomes: downgrades of a loan's credit rating and, among these, downgrades to "troubled." The declaration that a borrower is troubled requires an immediate write-down of the loan and is also tantamount to failure of the borrower; in almost all cases, the ultimate outcome is bankruptcy or liquidation (see the top panel of Table 1). Failure of the borrower is a more clearly objective event than a credit downgrade, which is explicitly subjective, and need not have immediate consequences. Thus we expect that signals of trouble will have quick and full impacts on credit downgrades – and that is what we find.

4.3 Usefulness of the bank balance data for monitoring borrowers

We ran OLS regressions and logit regressions of whether a loan was eventually declared troubled on *violations*, *nonviolations*, and *utilization*. The OLS results for exclusive clients are shown in Table 3.[13] First note that the coefficients have the expected signs. Moreover, asymptotic F-tests indicate that the null hypothesis that the *violations* and *nonviolations* can be excluded is rejected at a high level of significance. The results are little changed if we exclude borrowers for which the bank lacks information about violations.

The coefficients are also economically significant. *Violations* has a standard deviation of 8.1, *nonviolations* has a standard deviation of 10.5; thus, a one-standard-deviation increase in either increases the probability of being declared troubled by roughly 10 percent. As we shall see, these results understate the value of these data, as it is mainly recent violations that determine credit rating changes and declarations of "troubled."

4.4 Speed with which the lender acts on signals from the bank balance

How quickly is this information used? Two pieces of evidence suggest that the information is used relatively soon after it is available. Most of the information that determines whether a loan is declared troubled is in violations in the most recent fiscal year before a declaration of trouble, as shown in Table 4. Here we use our disaggregated measures of violations, *violations_1*, *violations_2*, and *violations_3*, which give separate counts of the number of violations according to how far in advance they took place before the loan was declared troubled (or before the final fiscal year for healthy borrowers). The results in Table 4 are based on the sample of exclusive loans, omitting those for which there was no information on violations during the third year prior to declaration. The first column of Table 4 shows the regression results for whether or not loans were declared "troubled." The coefficients on the three violations variables are jointly strongly significantly different from zero. The bulk of the information is

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[13]The logit results are qualitatively the same and are available upon request from the authors.

derived from the last year: the coefficients on violations in the two earlier years are jointly statistically insignificant.

Violations in the last year (*violations_1*) are also important economically. The standard deviation of this variable is 3.55, so a one-standard-deviation increase in violations in the last year raises the probability of being declared troubled by 32 percentage points.

A one-standard-deviation increase in credit utilization raises the probability of being declared troubled by 12 percentage points, an important amount, but less than for violations in the last year. It is interesting that temporally disaggregating credit utilization does not improve the fit. Indeed, substituting year-by-year data on credit utilization results in a jointly insignificant set of parameters (this result is not shown in the table but is available from the authors upon request).

Now consider downgrades of loans at the second review date, i.e., at least a year prior to when the loan was declared troubled.[14] Here we would expect that the most important information would be violations that occurred in the second year prior to the declaration that the loan is troubled, i.e., in the year prior to this particular downgrade. The second column in Table 4 shows that is indeed the case. Again, the coefficients on the three violations variables are jointly strongly significantly different from zero. Almost all the information provided by violations in explaining downgrades in the second year is contained in violations that occurred in the year prior to the downgrade (*violations_2)*: violations in the two other years are statistically insignificant. In addition, the information is quantitatively important: a one-standard-deviation change in violations in the second year raises the probability of a decline in credit rating by 21 percentage points. Again, temporally disaggregating credit utilization results in insignificant parameter estimates.

A third piece of evidence concerns profit movements. Somewhat to our surprise, declarations of troubled are not always preceded by negative profits; indeed, 16 of the 50 loans declared troubled had positive profits in the last annual report before being declared troubled. It appears that accounting profits

are a noisy measure of true profitability; in particular, assets that expanding firms have booked can lose value suddenly. Nevertheless, it is of interest to see whether violations are useful in signaling negative accounting profits. The results are in the third column in Table 4. Violations in all three years are related to negative profits in the last year before being declared troubled. Violations taken together are statistically significant, but the economic importance of violations in the last year is somewhat diminished compared to their economic importance in predicting whether the loan will be declared troubled or downgraded.

Taken together these results show that information on violations are highly significant and quantitatively important in periods immediately preceding loans being declared troubled when loans are made to borrowers whose only bank relationship is with the monitoring bank. The bank also uses such information quickly in determining credit downgrades. Violations are also informative about borrower profitability.

4.5 Impact of violations on monitoring

Results shown in our final two tables indicate that the lender intensifies its monitoring of risky loans by spending more time in loan review and by reducing the time between loan reviews. Evidence was gleaned by examining the date on which a credit review was completed relative to the date the review was planned to be completed and changes in the frequency of planned reviews.

We expect that violations trigger more intensive monitoring of loans. For loans with violations, the completion of the credit review should be later than the planned completion date relative to loans without violations, since the reviewer is likely to review loans with violations more closely. A credit review is typically prolonged by the bank's requests for additional information, such as more complete financial statements and more detail about projected future disbursements from the bank account. The

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[14]Since the results for downgrades at the final review date are virtually identical to the results for declarations of "trouble," we omit them here for brevity; they are available upon request from the authors.

bank may negotiate changes in the terms of the loan (for example, asking for personal guarantees, such as the pledge of property), and such negotiations may take time. Thus a lengthy delay between the expected loan review date and the sign-off by the loan officer is a strong sign that monitoring has been intensified. Similarly, we expect that violations are likely to trigger more frequent examination of the loans. Clearly, more frequent loan reviews are signs of more intensive monitoring, as they require more data collection and analysis per unit of time.

Table 5 sorts exclusive loans on the number of *violations* they eventually have – in particular, we divide the loans into two groups: those with *violations* less than or equal to the median level of *violations* over the sample of loans and those with *violations* greater than the median level. (The median level is 2.5 *violations* for all loans, exclusive and nonexclusive.) This is information that the bank can discern from a firm's checking account. First, we find that loans with greater numbers of *violations* do have their credit reviews delayed relative to loans that have fewer *violations*: for example, in the third year prior to our reference date, 86 percent of loans with fewer *violations* have a delayed review while in the first year prior, only 67 percent do; the length of delay declines from 108 days, on average, to 32 days. For loans with a greater number of *violations*, there is little decline in the number of delayed reviews and a much smaller decline in the average length of delay, compared to loans with fewer *violations*. Note that there is a significant difference in days delayed in the year prior to the reference date between loans with more violations and loans with fewer violations.

The bottom panel shows that the number of days between planned reviews increases for loans with fewer *violations* but declines for loans with a greater number of *violations*, and there is a statistically significant difference in the average number of days between planned reviews in the second year prior to the reference date for the two groups of loans.[15,16]

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[15]The right side of the bottom panel of Table 5 indicates there is little change over the three years in the number of high-violation loans whose planned reviews are significantly more than a year apart and there is little change in those whose planned reviews are less than a year apart. However, over the three years, the number of low-violation loans whose reviews are significantly more than a year apart increases. This

4.6 Monitoring troubled loans

We see similar patterns, and somewhat stronger ones, when we compare healthy and troubled loans. The evidence is that as loans deteriorate, monitoring becomes more intensive and costly. At the beginning of the period covered by our data (t−3), healthy loans were approximately as creditworthy as the troubled loans. Over time, the healthy loans, on average, improve in quality, while the troubled loans, by definition, deteriorate. Table 6 shows that among healthy loans, delays in loan reviews decrease compared to planned dates. For example, in the third year prior to our reference date, 88 percent of healthy loans have a delayed review, while, in the first year prior, only 69 percent do. Moreover, the length of delay is cut by three-fourths – from about 131 days to 40 days, on average. In contrast, for loans that remain troubled, there is little lessening in the number of delayed reviews or average length of delay, and the difference in the average number of days delayed in the year prior between the healthy and troubled loans is statistically significant.

The lower part of Table 6 shows that over time, as the troubled loans worsen, the time planned between credit reviews shortens on average, while for loans that improve in health, the time between reviews increases. For example, for troubled loans, on average, the time between planned reviews decreases by about 33 days over the three years, whereas for healthy loans, on average, planned reviews become less frequent by about 32 days.

Overall, the results in Tables 5 and 6 indicate that borrowers whose borrowing needs exceed the bank's valuations of accounts receivable and inventories and loans that become troubled have their credit ratings downgraded at the next credit review. Together with downgrading of credit, scrutiny appears to become stronger, with the credit review itself dragging on and the time between reviews sometimes becoming shorter.

increase is about the same as the increase in the number of low-violation loans whose reviews are significantly less than a year apart.

[16]Similar results are obtained if instead of dividing the loans into two groups, we divide them into three groups: *violations* = 0; 0 < *violations* ≤ 10; and *violations* > 10.

5. Conclusion

This paper has described the efforts of one Canadian bank to use information in transactions accounts to scrutinize the activities of small-business borrowers. It is clear from the evidence that the bank does use instances where borrowings exceed the bank's own valuation of a firm's accounts receivable and inventories as a signal of deterioration in credit. Moreover, movements in checking account balances are closely related to movements in the bank's valuation of accounts receivable and inventories, suggesting strongly that the checking account provides a relatively transparent window on these aspects of a firm's activity. Although our results pertain to only one bank, we believe that these results taken together provide detailed micro-level evidence that transactions account data are useful for monitoring borrowers. While any asset-based lender with access to transactions account data, such as finance companies, could use the information for monitoring the borrowers' operating loans, commercial banks are likely to be the most efficient at doing so, since they offer the transactions accounts.

Table 1. **Loan Summary Statistics**

Final outcome of the 50 firms whose loans became troubled: number and (percent) of the 50 troubled loans in the data set			
	Troubled Loans	**Exclusive, Troubled Loans**	**Nonexclusive, Troubled Loans**
Bankruptcy of the firm	10 (20%)	6 (12%)	4 (8%)
Private liquidation of the firm	26 (52%)	20 (40%)	6 (12%)
Loan remained troubled	9 (18%)	3 (6%)	6 (12%)
Loan repaid	4 (8%)	3 (6%)	1 (2%)
Loan upgraded to healthy	1 (2%)	0 (0%)	1 (2%)

Table 1, con't. Loan Summary Statistics

Average loan size and average business sales (in thousands of Canadian dollars)*									
	All Loans	**Healthy Loans**	**Troubled Loans**	**Exclusive Loans**	**Nonexclusive Loans**	**Exclusive, Healthy Loans**	**Nonexclusive, Healthy Loans**	**Exclusive, Troubled Loans**	**Nonexclusive, Troubled Loans**
Average loan size									
All three years	$1496.3 (2485.8)	$1269.9 (2828.8)	$1741.1 (2024.3)	$1365.8 (1994.6)	$1745.3 (3207.9)	$883.4 (1612.5)	$1849.9 (3945.6)	$1802.5 (2197.5)	$1585.9 (1491.1)
Three years prior to reference date	1250.8 (2216.9)	1126.4 (2546.4)	1400.8 (1730.1)	1088.5 (1682.3)	1593.0 (3028.2)	797.3 (1494.6)	1705.7 (3674.8)	1396.6 (1813.2)	1412.2 (1495.1)
Two years prior to reference date	1500.9 (2388.7)	1231.5 (2608.3)	1783.7 (2099.8)	1364.9 (2096.2)	1762.3 (2853.8)	836.7 (1686.6)	1843.7 (3516.8)	1839.7 (2307.0)	1646.6 (1472.2)
One year prior to reference date	1679.4 (2745.7)	1426.2 (3229.3)	1938.5 (2113.2)	1592.1 (2095.8)	1832.9 (3613.7)	1014.2 (1635.3)	1953.8 (4462.9)	2056.4 (2302.1)	1642.8 (1508.6)
Average annual business sales									
All three years	$16,898.0 (36,811.3)	$12,805.2 (16,445.5)	$20,990.8 (49,327.0)	$10,108.8 (9,379.2)	$26,667.9 (55,321.0)	$10,742.0 (10,363.2)	$15,040.4 (21,199.6)	$9,609.8 (8,657.9)	$43,083.4 (80,721.0)
Three years prior to reference date	15,885.3 (38,803.3)	10,846.5 (10,836.6)	20,924.0 (53,599.2)	9,746.7 (10,120.9)	24,718.8 (58,672.9)	10,405.2 (10,448.1)	11,324.6 (11,448.5)	9,227.8 (9,987.4)	43,628.2 (88,141.0)
Two years prior to reference date	18,112.0 (42,688.4)	14,028.5 (23,514.0)	22,195.4 (55,631.4)	9,934.8 (9,497.2)	29,879.1 (64,333.9)	10,855.6 (10,958.3)	17,465.9 (31,995.2)	9,209.3 (8,272.5)	47,403.6 (91,203.8)
One year prior to reference date	16,696.9 (30,621.6)	13,540.6 (17,004.6)	19,853.1 (39,812.2)	10,644.8 (10,173.4)	25,406.0 (45,154.4)	10,965.2 (9,796.3)	16,330.6 (22,273.3)	10,392.3 (10,605.1)	38,218.2 (63,923.3)

*Averaged over months and firms, with standard deviation of loan size or business sales in parentheses. For healthy loans, the reference date is the last time the firm's credit file was reviewed by the bank. For troubled loans, the reference date is the date when the loan was declared troubled.

Table 1, con't. Loan Summary Statistics

Credit Ratings for Loans									
				─── Reservations ───				─── Troubled ───	
	Superior = 1	Standard = 2	Mild = 3	Average = 4	Strong = 5		Standard = 6	Severe = 7	Very Severe = 8
Healthy Loans									
No. of Loans at t−3	4	15	23	0	8				
No. of Loans at t−2	3	17	23	0	7				
No. of Loans at t−1	4	19	18	0	9				
Exclusive, Healthy Loans									
No. of Loans at t−3	2	9	11	0	4				
No. of Loans at t−2	2	10	12	0	2				
No. of Loans at t−1	3	12	8	0	3				
Nonexclusive, Healthy Loans									
No. of Loans at t−3	2	6	12	0	4				
No. of Loans at t−2	1	7	11	0	5				
No. of Loans at t−1	1	7	10	0	6				
Troubled Loans									
No. of Loans at t−3	3	15	28	0	4		0	0	0
No. of Loans at t−2	1	2	14	1	31		0	0	0
No. of Loans at t−1	0	1	2	1	6		29	5	6
Exclusive, Troubled Loans									
No. of Loans at t−3	1	8	29	0	4		0	0	0
No. of Loans at t−2	1	1	9	1	20		0	0	0
No. of Loans at t−1	0	1	2	1	3		19	4	3
Nonexclusive, Troubled Loans									
No. of Loans at t−3	2	7	8	0	0		0	0	0
No. of Loans at t−2	0	1	5	0	11		0	0	0
No. of Loans at t−1	0	0	0	0	3		10	1	3

Table 2.   **Distribution of Loans by Industry†**

	% of sample (100 loans)	% of exclusive loans (59 loans)	% of nonexclusive loans (41 loans)	% of healthy loans (50 loans)	% of troubled loans (50 loans)
Manufacturing	42.0%	42.4%	41.5%	42.0%	42.0%
Wholesale Trade	20.0%	27.1%	9.8%	20.0%	20.0%
Services	20.0%	15.3%	26.8%	20.0%	20.0%
Retail Trade	10.0%	8.5%	12.2%	10.0%	10.0%
Construction	6.0%	5.1%	7.3%	6.0%	6.0%
Primary (Mining, Agriculture, Fishing, Forestry)	2.0%	1.7%	2.4%	2.0%	2.0%

†Exclusive loans are loans made to firms that have an exclusive banking relationship with the bank. Nonexclusive loans are loans made to firms that have relationships with other banks as well. Note, the distributions of healthy and troubled loans by industry are identical because pairs were matched on industry category. Second and third columns do not sum to 100% due to rounding.

Table 3. Regression Results of Exclusive Troubled Loans on Signs of Trouble in All Three Prior Years†

	Dependent variable: Dummy variable equal to 1 for loans declared troubled and equal to 0 otherwise		
Intercept	0.366** (0.202) $p=0.076$	0.568* (0.227) $p=0.016$	0.341* (0.082) $p=0.000$
Violations	0.0137 (0.0095) $p=0.154$	0.0186** (0.0093) $p=0.051$	0.0248* (0.0062) $p=0.000$
Nonviolations	-0.0078 (0.0065) $p=0.237$	-0.0082 (0.0074) $p=0.276$	
Credit Utilization	0.389* (0.114) $p=0.001$		
Asymptotic F-test for violations and nonviolation exclusion	$F(2,52)$ $=5.18*$ $p=0.0089$	$F(2,54)$ $=10.15*$ $p=0.0002$	
No. of Observations	56	57	57

†Includes all exclusive loans with information on violations or nonviolations.
 Ordinary least squares regressions. White robust standard errors in parentheses. p-values in italics.
*Significant at 5% level. ** Significant at 10% level.

Violations is the number of months in the three years prior to the reference date in which the amount the firm has borrowed is greater than the firm's collateral (as measured by the bank's valuation of the firm's accounts receivable and inventories and other guarantees posted by the firm); the reference date is the date when a loan was declared troubled for troubled loans, and the date of a healthy loan's last credit review for healthy loans. Similarly, *nonviolations* is the number of months in the three years prior to our reference date in which borrowing is less than collateral. Months in which our data are incomplete so that *violations* and *nonviolations* cannot be computed do not increase either *violations* or *nonviolations*. Thus, if data are missing, or if the firm is just borrowing an amount equal to the bank's valuation of its collateral, the sum of *violations* and *nonviolations* will differ from 36, and therefore, both variables can be included in the regression. *Credit utilization* is the firm's borrowing as a percent of its authorized credit line.

The mean and standard deviations (in paretheses) of the variables used in the regressions in the sample with 56 observations are as follows: *violations*: 7.89 (8.15); *nonviolations*: 21.43 (10.17); *credit utilization*: 0.587 (0.428); *declaration of troubled*: 0.536 (0.503).

Table 4. Regression Results of Exclusive Troubled Loans, Credit Downgrades in the 2ⁿᵈ Year Before Classification, and Negative Profits in the Year Before Classification on Signs of Trouble in Each of Three Prior Years†

	Dependent variable: Dummy variable equal to 1 for loans declared troubled and equal to 0 otherwise	Dependent variable: Dummy variable equal to 1 for loans whose credit rating was lowered in the next to last credit review before being declared troubled, and equal to 0 otherwise	Dependent variable: Dummy variable equal to 1 for loans whose profits were negative at the time of last credit review before being declared troubled, and equal to 0 otherwise
Intercept	0.1122 (0.0758) *p=0.147*	0.00954 (0.0744) *p=0.899*	0.1187 (0.0833) *p=0.162*
Violations, 1 year prior to declaration of "**troubled**"	0.0897* (0.0227) *p=0.000*	0.02796 (0.0251) *p=0.272*	0.0455* (0.0210) *p=0.036*
Violations, 2 years prior to declaration of "**troubled**"	-0.0499** (0.0267) *p=0.070*	0.0587** (0.0316) *p=0.071*	−0.0686* (0.0243) *p=0.045*
Violations, 3 years prior to declaration of "**troubled**"	0.0335 (0.0197) *p=0.207*	-0.0337 (0.0213) *p=0.123*	0.0608* (0.0293) *p=0.045*
Credit Utilization	0.2572** (0.1328) *p=0.060*	0.2987 (0.1549) *p=0.186*	0.0925 (0.1553) *p=0.555*
Asymptotic F-test for excluding the variables violations 1,2, and 3 years prior to declaration of "**troubled**"	$F_{(3,39)}$ =6.32* *p=0.0013*	$F_{(3,39)}$ =4.49* *p=0.0084*	$F_{(3,39)}$ =4.12* *p=0.0125*
Asymptotic F-test for excluding violations:	2 & 3 years prior: $F_{(2,39)}$ =1.74 *p=0.1885*	1 & 3 years prior: $F_{(2,39)}$ =2.11 *p=0.1349*	2 &3 years prior: $F_{(2,39)}$ =4.19* *p=0.0225*
No. of Observations	44	44	44

† Exclusive loans with information on violations or nonviolations in the 3rd year. Ordinary least squares regressions. White robust standard errors in parentheses. p-values in italics.
*Significant at 5% level. ** Significant at 10% level.

Violations_i is the number of months in year *i* prior to the reference date in which the amount the firm has borrowed is greater than the firm's collateral (as measured by the bank's valuation of the firm's accounts receivable and inventories and other guarantees posted by the firm), $i = 1,2,3$; the reference date is the date when a loan was declared troubled for troubled loans, and the date of a healthy loan's last credit review for healthy loans. Similarly, *nonviolations_i* is the number of months in year *i* prior to our reference date in which borrowing is less than collateral. *Credit utilization* is the firm's borrowing as a percent of its authorized credit line.

The mean and standard deviations (in parentheses) of the variables used in the regressions in the sample with 44 observations are as follows: *violations_1*: 3.36 (3.55); *violations_2*: 2.97 (3.54); *violations_3*: 2.48 (3.27); *credit utilization*: 0.590 (0.469); *declaration of troubled*: 0.500 (0.506); *downgrade two years prior*: 0.318 (0.471); *negative profit one year prior*: 0.273 (0.451).

Table 5. Evidence of More Intensive Monitoring in Response to Violations Based on the Monthly Bank Account Information for Exclusive Loans†

Delayed Completion of Review

	% of Delayed Reviews			Average Number of Days Delayed			Median Number of Days Delayed		
	3rd year prior	2nd year prior	year prior	3rd year prior	2nd year prior	year prior	3rd year prior	2nd year prior	year prior
Loans with ≤ Median No. of Violations	86%	81%	67%	107.9	90.8	31.6*	118.0	102.0	24.0*
Loans with > Median No. of Violations	89%	86%	81%	145.0	109.3	120.8*	131.0	100.5	92.5*

Times Between Planned Reviews

	Average Number of Days Between Planned Reviews		Average Change in Number of Days Between Planned Reviews	Percentage of Loans Whose Days Between Planned Reviews Are:			
				> 390	< 340	>390	< 340
	3rd year prior to 2nd year prior	2nd year prior to year prior	Between 3rd year prior to 2nd year prior and 2nd year prior to year prior	3rd year prior to 2nd year prior		2nd year prior to year prior	
Loans with ≤ Median No. of Violations	372.3	387.2**	Number of days between planned reviews increases, on average, by 14.9 days	9.5%	9.5%**	33.3%	9.5%
Loans with > Median No. of Violations	357.5	344.9**	Number of days between planned reviews decreases, on average, by 13.2 days	22.9%	28.6%**	25.0%	27.8%

†For all exclusive loans categorized by whether the number of violations is greater or less than the median number of violations in the sample of all loans.
A *delayed review* is one in which the credit review is completed after the planned credit review date. The *number of days delayed* is the calendar number of days from the planned credit review date to the credit review completion date. Similarly, the *number of days between planned reviews* is the calendar number of days from one planned credit review to the next.

*Values for loans with the number of violations less than or equal to the median are significantly different from the values for loans with the number of violations greater than the median at the 5% level.
**Values for loans with the number of violations less than or equal to the median are significantly different from the values for loans with the number of violations greater than the median at the 10% level.

Table 6. Evidence of More Intensive Monitoring as Loans Deteriorate for Exclusive Loans†

Delayed Completion of Review

	% of Delayed Reviews			Average Number of Days Delayed			Median Number of Days Delayed		
	3rd year prior	2nd year prior	year prior	3rd year prior	2nd year prior	year prior	3rd year prior	2nd year prior	year prior
Healthy Loans	88%	85%	69%	131.4	85.1	40.3*	122.5	100.5	19.5
Troubled Loans	87%	84%	81%	130.7	117.1	127.8*	120.0	114.0	107.0

Times Between Planned Reviews

	Average Number of Days Between Planned Reviews		Average Change in Number of Days Between Planned Reviews	Percentage of Loans Whose Days Between Planned Reviews Are:			
				> 390	< 340	> 390	< 340
	3rd year prior to 2nd year prior	2nd year prior to year prior	Between 3rd year prior to 2nd year prior and 2nd year prior to year prior	3rd year prior to 2nd year prior		2nd year prior to year prior	
Healthy Loans	370.9	402.8*	Number of days between planned reviews increases, on average, by 31.88 days*	11.5%	11.5%**	38.5%	3.8%*
Troubled Loans	356.3	325.0*	Number of days between planned reviews decreases, on average, by 32.6 days*	23.3%	30.0%**	19.4%	35.5%*

†For all loans categorized by healthy vs. troubled.

A *delayed review* is one in which the credit review is completed after the planned credit review date. The *number of days delayed* is the calendar number of days from the planned credit review date to the credit review completion date. Similarly, the *number of days between planned reviews* is the calendar number of days from one planned credit review to the next.

*Values for healthy and troubled loans are significantly different from each other at the 5% level.
**Values for healthy and troubled loans are significantly different from each other at the 10% level.

Appendix 1.
 Representative Loan Contract

A representative loan contract for the bank we study included the following language:

> "Total outstandings are not to exceed 75% of good accounts receivable,
>
> excluding accounts over 90 days and inter-company accounts plus 50% of inventory, up
>
> to a maximum of $5 million dollars, including raw material, work in process and finished
>
> products, less priority claims."

> "The Borrower will deliver to the Bank such financial information as the Bank may
>
> reasonably request including but not limited to the following:
>
> a) audited annual financial statements of the Borrower, within 90 days after the
>   fiscal year end;
>
> b) in-house monthly financial statements of the Borrower within 20 days after
>   the end of the month;
>
> c) monthly aged listing of accounts receivable and inventory reports within 20
>   days after the end of month."

A simple accounting model

A simple accounting model shows the relationship between changes in accounts receivable, inventories, and bank account balance. In month t, the borrowing firm makes expenditures x_t to make products that increase the firm's inventories. It also makes shipments, y_t, which reduce inventories and increase accounts receivable. Then if the firm sells its products at a constant markup of m, shipments will increase accounts receivable by $y_t(1+m)$. At time t, the firm will also receive some payments z_t on past shipments, which decrease accounts receivable. Net operating outlays are then $x_t - z_t$. Let all other net outlays be w_t; these will include liquidity declines caused by unanticipated operating losses or expenditures.

Let the firm's bank balance (i.e., what it owes the bank lender, on net) be B_t, and let the monthly interest rate on the loan (assumed constant over time) be r. Then $B_t = B_{t-1}(1+r) + x_t - z_t + w_t$. Similarly, let R_t be accounts receivable and S_t be inventories. Then $R_t = R_{t-1} + y_t(1+m) - z_t$ and $S_t = S_{t-1} + x_t - y_t$.

The changes in bank balances, accounts receivable, and inventories are:

$$\Delta B_t = B_{t-1}r + x_t - z_t + w_t, \tag{A.1}$$

$$\Delta R_t = y_t(1+m) - z_t, \tag{A.2}$$

$$\Delta S_t = x_t - y_t. \tag{A.3}$$

The sum of changes in accounts receivable and inventories will approximately equal changes in bank balance, depending on the relative size of interest accruals (which depend on r), markup (m), and net other outlays (w_t). The size of interest accruals are, of course, known to the lender, as is the expected markup. Thus, if the lender knows the changes in inventories and accounts receivable, then knowledge of the bank balance is equivalent to knowledge of other net outlays.

The reverse is true too. If movements in w_t are infrequent, the bank balance can generally be used to monitor changes in inventory and accounts receivable.

The correlation between changes in the loan balance and the bank's valuation of accounts receivable

To the extent that there is a high correlation between bank account balances and changes in accounts receivable and inventories, changes in the firm's bank account balance can be used to monitor a firm's operations.

We can derive approximate values of the correlations under certain simplifying assumptions. For example, suppose the bank values the collateral represented by the accounts receivable at vR. (It applies a haircut, since there is some chance the accounts receivable will not be collected.) Then, using equation (2) in the text, the change in the bank's valuation of accounts receivable is $\Delta vR_t = vR_t - vR_{t-1} = v[y_t(1+m) - z_t]$. If m is small, then

$$\Delta vR_t \approx v(y_t - z_t). \tag{A.4}$$

The correlation between the change in the firm's bank account balance and the change in the bank's valuation of the firm's accounts receivable is

$$corr(\Delta B_t, \Delta vR_t) = covariance(\Delta B_t, \Delta vR_t) / [variance(\Delta B_t)^{1/2} \, variance(\Delta vR_t)^{1/2}].$$

Using equations (A.1) and (A.4), and assuming r is small, then

$corr(\Delta B_t, \Delta vR_t)$

$$\approx cov(x_t - z_t + w_t, v(y_t - z_t)) / [var(x_t - z_t + w_t)^{1/2} var(v(y_t - z_t))^{1/2}]$$

$$= \{[v\ cov(x_t,y_t) - v\ cov(x_t,z_t) - v\ cov(z_t,y_t) + v\ var(z_t) + v\ cov(w_t,y_t) - v\ cov(w_t,z_t)]\}/$$

$$\{[var(x_t) + var(z_t) + var(w_t) - 2cov(x_t,z_t) - 2cov(z_t,w_t) + 2cov(x_t,w_t)]^{1/2} \times$$

$$[v^2\ var(y_t) + v^2\ var(z_t) - 2\ v^2 cov(y_t,z_t)]^{1/2}\}.$$

As an approximation, assume x_t, y_t, z_t, w_t are independent. Then,

$$corr(\Delta B_t, \Delta vR_t) = [var(z_t)] / [var(x_t) + var(z_t) + var(w_t)]^{1/2}\ [var(y_t) + var(z_t)]^{1/2}.$$

If other payments are not variable, i.e., $var(w_t) = 0$ and the variance in goods purchased, goods sold, and payments received is similar, i.e., $var(x_t) = var(y_t) = var(z_t)$, then

$$corr(\Delta B_t, \Delta vR_t) \approx [var(z_t)] / [2var(z_t)]^{1/2}\ [2var(z_t)]^{1/2} = 1/2.$$

A similar calculation can be performed for the correlation between the change in bank account balance and the change in inventories. Table A1.1 shows the correlations by loan category.

Obviously, this is a rough approximation, based on a number of simplifying assumptions. But it gives an idea of the magnitude of the correlation we would need to find to anticipate that the bank account balance might be a useful indicator of firm operations.

Table A1.1. Correlations and Variances of Monthly Changes in Bank Account Balances, Bank's Valuation of Accounts Receivable and Inventories

This table reports the correlations and variances by category of loan of monthly changes in the borrowers' bank account balances and the bank's valuation of the borrowers' accounts receivable and inventories. A positive bank account balance corresponds to a firm's borrowings exceeding its deposits; a negative bank account balance corresponds to a firm's deposits exceeding its borrowings. Thus, positive bank account balances indicate the firm is borrowing, on net. The correlations are between monthly changes, scaled by dividing by annual sales. For troubled loans, this is sales in the fiscal year three years prior to the loans' being declared troubled, and for healthy loans, this is sales in the fiscal year three years prior to the last credit file review.

Correlations between changes in:	Total	Exclusive Loans	Nonexclusive Loans	Exclusive, Healthy Loans	Nonexclusive, Healthy Loans	Exclusive, Troubled Loans	Nonexclusive, Troubled Loans
Bank Account Balances and Accounts Receivable	0.44*	0.49*	0.31*	0.54*	0.34*	0.44*	0.28*
Bank Account Balances and Inventories	0.19*	0.13*	0.28*	0.18*	0.36*	0.11*	0.19*
Inventories and Accounts Receivable	−0.08*	−0.10*	−0.06	−0.10*	0.07	−0.10*	−0.20*
No. of Observations	1327	1024	303	514	142	510	161

*Significantly different from zero at the 5% level.

Variances of changes in:	Total	Exclusive Loans	Nonexclusive Loans	Exclusive, Healthy Loans	Nonexclusive, Healthy Loans	Exclusive, Troubled Loans	Nonexclusive, Troubled Loans
Bank Account Balances	0.00233	0.00209	0.00315	0.00207	0.00367	0.00211	0.00272
Accounts Receivable	0.00198	0.00204	0.00178	0.00226	0.00177	0.00182	0.00180
Inventories	0.00053	0.00040	0.00098	0.00023	0.00112	0.00057	0.00085

Appendix 2. Results using all loans (exclusive and nonexclusive loans)

The following tables report comparable results to tables 3 to 6 in the paper using all the loans instead of just exclusive loans.

Table A2.1. Regression Results of Troubled Loans on Signs of Trouble in All Three Years Prior (comparable to Table 3 results in the paper but using all loans instead of just exclusive loans)†

Dependent variable: Dummy variable equal to 1 for loans declared troubled and equal to 0 otherwise	All Loans	All Loans with Information On Violations or Nonviolations		
Intercept	0.330*	0.151	0.388*	0.278*
	(0.130)	(0.150)	(0.168)	(0.0636)
	p=0.013	*p=0.318*	*p=0.024*	*p=0.000*
Violations	0.0158*	0.017*	0.0215*	0.0285*
	(0.0072)	(0.0084)	(0.0079)	(0.0055)
	p=0.030	*p=0.042*	*p=0.008*	*p=0.000*
Nonviolations	-0.010*	-0.0071	-0.0075	
	(0.0047)	(0.0053)	(0.0059)	
	p=0.034	*p=0.189*	*p=0.207*	
Credit Utilization	0.236*	0.353*		
	(0.075)	(0.098)		
	p=0.002	*p=0.001*		
Exclusive Client Dummy	Yes	Yes	Yes	No
Asymptotic F-test for violations and nonviolation exclusion	$F_{(2,81)}$ =11.03* *p=0.0001*	$F_{(2,73)}$ =8.20* *p=0.0006*	$F_{(2,77)}$ =13.69* *p=0.0000*	
No. of Observations	86	78	81	81

†Ordinary least squares regressions. White robust standard errors in parentheses. p-values in italics.
*Significant at 5% level. ** Significant at 10% level.

Violations is the number of months in the three years prior to the reference date in which the amount the firm has borrowed is greater than the firm's collateral (as measured by the bank's valuation of the firm's accounts receivable and inventories and other guarantees posted by the firm); the reference date is the date when a loan was declared troubled for troubled loans, and the date of a healthy loan's last credit review for healthy loans. Similarly, *nonviolations* is the number of months in the three years prior to our reference date in which borrowing is less than collateral. Months in which our data are incomplete so that *violations* and *nonviolations* cannot be computed do not increase either *violations* or *nonviolations*. Thus, if data are missing, or if the firm is just borrowing an amount equal to the bank's valuation of its collateral, the sum of *violations* and *nonviolations* will differ from 36, and therefore, both variables can be included in the regression. *Credit utilization* is the firm's borrowing as a percent of its authorized credit line.

Table A2.2. Regression Results of Troubled Loans, Credit Downgrades in the 2nd Year Before Classification, and Negative Profits in the Year Before Classification on Signs of Trouble in Each of Three Prior Years (comparable to Table 4 results in the paper but using all loans rather than just exclusive loans)†

	Dependent variable: Dummy variable equal to 1 for loans declared troubled and equal to 0 otherwise	Dependent variable: Dummy variable equal to 1 for loans whose credit rating was lowered in the next to last credit review before being declared troubled, and equal to 0 otherwise	Dependent variable: Dummy variable equal to 1 for loans whose profits were negative at the time of last credit review before being declared troubled, and equal to 0 otherwise
Intercept	0.0753 (0.0643) *p=0.247*	−0.1909 (0.0664) *p=0.776*	0.0857 (0.0785) *p=0.280*
Violations, 1 year prior to declaration of "**troubled**"	0.0831* (0.0214) *p=0.000*	0.0410** (0.0214) *p=0.061*	0.0430** (0.0222) *p=0.057*
Violations, 2 years prior to declaration of "**troubled**"	-0.0217 (0.0225) *p=0.338*	0.0498* (0.0229) *p=0.034*	−0.0443 (0.0273) *p=0.110*
Violations, 3 years prior to declaration of "**troubled**"	0.0201 (0.0210) *p=0.343*	-0.0299 (0.0184) *p=0.110*	0.0426** (0.0243) *p=0.085*
Credit Utilization	0.2273* (0.1117) *p=0.047*	0.2206 (0.1369) *p=0.113*	0.1707 (0.1427) *p=0.237*
Asymptotic F-test for excluding the variables violations 1,2, and 3 years prior to declaration of "**troubled**"	F(3,55) =9.25* *p=0.0000*	F(3,55) =7.25* *p=0.0004*	F(3,55) =3.08* *p=0.0350*
Asymptotic F-test for excluding violations:	2 & 3 years prior: F(2,55)=.62 *p=..5410*	1 & 3 years prior: F(2,55)=2.73 *p=.0741*	2 & 3 years prior: F(2,55)=1.90 *p=0.1599*
No. of Observations	60	60	60

† All loans with information on violations or nonviolations in the 3rd year. Ordinary least squares regressions. White robust standard errors in parentheses. p-values in italics.
*Significant at 5% level. ** Significant at 10% level.

Violations and credit utilization are defined as in Table 4.

Table A2.3. Evidence of More Intensive Monitoring in Response to Violations Based on the Monthly Bank Account Information for All Loans (comparable to results in Table 5 but using all loans instead of just exclusive loans)†

Delayed Completion of Review

	% of Delayed Reviews			Average Number of Days Delayed			Median Number of Days Delayed		
	3rd year prior	2nd year prior	year prior	3rd year prior	2nd year prior	year prior	3rd year prior	2nd year prior	year prior
Loans with ≤ Median No. of Violations	90%	80%	69%	118.1	98.9	48.1*	118.0	99.0	51.0*
Loans with > Median No. of Violations	85%	90%	79%	124.7	111.5	104.5*	111.0	105.0	83.0*

Times Between Planned Reviews

	Average Number of Days Between Planned Reviews		Average Change in Number of Days Between Planned Reviews	Percentage of Loans Whose Days Between Planned Reviews Are:			
				> 390	< 340	>390	< 340
	3rd year prior to 2nd year prior	2nd year prior to year prior	Between 3rd year prior to 2nd year prior and 2nd year prior to year prior	3rd year prior to 2nd year prior		2nd year prior to year prior	
Loans with ≤ Median No. of Violations	367.1	354.6	Number of days between planned reviews <u>decreases,</u> on average, by 9.94 days	10.4%	12.5%	20.8%	24.5%
Loans with > Median No. of Violations	363.6	347.7	Number of days between planned reviews <u>decreases,</u> on average, by 16.98 days	21.7%	23.9%	27.1%	27.1%

†For all loans categorized by whether the number of violations is greater or less than the median number of violations in the sample of all loans.
A *delayed review* in one in which the credit review is completed after the planned credit review date. The *number of days delayed* is the calendar number of days from the planned credit review date to the credit review completion date. Similarly, the *number of days between planned reviews* is the calendar number of days from one planned credit review to the next.

*Values for loans with the number of violations less than or equal to the median are significantly different from the values for loans with the number of violations greater than the median at the 5% level.

Table A2.4. Evidence of More Intensive Monitoring as Loans Deteriorate†

Delayed Completion of Review

	% of Delayed Reviews			Average Number of Days Delayed			Median Number of Days Delayed		
	3rd year prior	2nd year prior	year prior	3rd year prior	2nd year prior	year prior	3rd year prior	2nd year prior	year prior
Healthy Loans	90%	84%	69%	119.6	89.0	37.8*	118.0	99.0	24.0*
Troubled Loans	84%	85%	79%	123.2	121.6	115.0*	111.0	117.0	92.0*

Times Between Planned Reviews

	Average Number of Days Between Planned Reviews		Average Change in Number of Days Between Planned Reviews	Percentage of Loans Whose Days Between Planned Reviews Are:			
				> 390	< 340	> 390	< 340
	3rd year prior to 2nd year prior	2nd year prior to year prior	Between 3rd year prior to 2nd year prior and 2nd year prior to year prior	3rd year prior to 2nd year prior		2nd year prior to year prior	
Healthy Loans	365.0	383.3*	Number of days between planned reviews increases, on average, by 18.37 days*	10.2%	14.3%	28.6%	12.2%*
Troubled Loans	365.8	318.1*	Number of days between planned reviews decreases, on average, by 47.96 days*	22.2%	22.2%	18.8%	39.6%*

†For all loans categorized by healthy vs. troubled.
A *delayed review* in one in which the credit review is completed after the planned credit review date. The *number of days delayed* is the calendar number of days from the planned credit review date to the credit review completion date. Similarly, the *number of days between planned reviews* is the calendar number of days from one planned credit review to the next.

*Values for healthy and troubled loans are significantly different from each other at the 5% level.

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